REMARKS

This Amendment, filed in reply to the Office Action dated May 25, 2006, is believed to be fully responsive to each point of rejection raised therein. Accordingly, favorable reconsideration on the merits is respectfully requested.

Claims 1, 3-21 and 23-42 are all the claims pending in the application.

Claim Rejections – 35 USC § 103

On Page 3, paragraph 5 of the Office Action, the Examiner rejected claims 1, 3, 6-12, 16, 17, 23, 26-30, 34, 35, and 39-42 under 35 U.S.C. 103(a) as being unpatentable over Hiller et al. (US 6,233,024 as cited in the previous office action) in view of Tejima et al. (US 5,274,406).

With regards to claims 1 and 21 of the subject application, the Examiner has specifically made reference to Hiller column 2, lines 56-67, and reference elements 1 and 3 in Figures 4 and 6 of Hiller and is of the opinion that Hiller discloses the image processing unit, projection light engine and optical reflection assembly recited in Applicant's claim 1. The Examiner is further of the opinion that: "*Tejima teaches in figure 13c a projector similar to that of Hiller. Figure 14a of Tejima shows a mirrored surface that is curved in the claimed manner.*" The Examiner further has referenced Tejima column 4, lines 35-59 and is further of the opinion that: " *The rear projection displays such as Hiller can be made thinner if the distortion caused by the inclination of the optical axis of the projection lens is compensated for. The curved mirror taught by Tejima in figure 13c compensates for distortions caused by the inclination. Accordingly since it is desirable to make the display as thin as possible while eliminating distortions; it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a curved mirror as taught by Tejima in the projection system of Hiller.*"

In response, the Applicant has amended claims 1 and 21 such that they now specifically relate to an two-dimensional array of pixels. The Applicant respectfully submits that Hiller does not provide each of the elements claimed in Applicant's claim 1. For instance, the passage cited by the Examiner, teaches that: "... a computing device is provided for recalculating the video picture prior to projection due to oblique projection or curvature of the deflecting mirror and a control device is provided which controls the deflection and/or intensity modulation of the light bundle, so that there appears on the screen in the image direction a virtually undistorted video picture which diverges from an equal distribution of lines by less than 30%, particularly less than 10%, with respect to line spacing" (Hiller, Column 2, Lines 56-67). Similar statements are made in claim 3 of Hiller.

The Applicant submits that the image processing unit in Applicant's amended claim 1, demonstrated in Figures 5 and 22, and described in paragraph 133 through paragraph 139 of the disclosure is not anticipated by the teachings of Hiller for the following reasons: The subject matter of one aspect of the Applicant's amended claim 1 involves the use of luminance correction and digital two-dimensional image warping applied to data representing a two-dimensional array of pixels driving the input of a light modulating micro-display device (such as a DMD device, an LCoS device (or devices), or high temperature polysilicon LCD devices from, for example). All of these devices, though differing in the individual method of modulating light, create an image on the surface of the micro-display that can then be magnified and projected on a screen. The entire image frame must be created and written to the image modulator at once, however, the data must be specific to one color at a time so typically 3 devices are needed, illuminated by

three different colors of light or a single device is used successively being illuminated by 3 different colors of light.

The device of Hiller, on the other hand, is intended for use in a scanned-laser rear projection display system, which in some ways resembles a traditional cathode ray tube (CRT) based TV. In a CRT, an image raster is created by deflecting an intensity-modulated electron beam across the width of a row of phosphors (at a 15kHz rate, for example) to create successively excited dots and deflecting the electron beam downward after every line to create more lines until the whole image has been written in a small enough interval (32ms-40ms) that the human eye perceives a complete image. A raster-scanned laser RPTV, like the Hiller device, creates images by using the deflection of intensity modulated laser sources (red, green, and blue laser beams) across the screen from one side to the other and downward, in a similar fashion. Typically, the bundle of R, G, and B beams are deflected from a small mirror which oscillates from side-to-side at the horizontal line rate (15kHz, for example) creating a line. This deflected light can be further reflected from another mirror which oscillates up and down at the field rate (60Hz, for example) and the light bundle, after undergoing these two deflections, impinges on the screen to create the visible image raster. These two deflecting mirrors are very small and need to have very low inertia as they oscillate at frequencies of at least 15kHz and are typically driven by small piezoelectric actuators or by speaker voice-coil type magnetic means.

The Applicant therefore submits that the method of Hiller applies exclusively to laser-illuminated systems; the laser beam is a point source and needs to be deflected by small mirrors to create a raster to cover the image to be displayed. In contrast, the corresponding aspect of Applicant's amended claim 1, however, applies to a two-dimensional, fixed-intensity, area source

of light, created by a rectangular beam of light either passing through or reflecting from a rectangular array of pixels, each of which is capable of modulating the light striking it. There are no moving parts in micro-displays, with the exception of DMD devices in which the individual micro-mirrors oscillate typically at multiple megahertz rates in order to pulse width modulate light.

In Column 2 lines 56-67 of Hiller (same paragraph as cited by the Examiner), it mentions: "a control device is provided which controls the deflection and/or intensity modulation of the light bundle...". It is obvious from the concurrence of the computing device and mentioned control device in the same sentence that Hiller uses these two devices together. The word "deflection", in the same sentence, refers to deflecting an intensity modulated laser beam as also stated in Hiller, column 6, line 18. The control device is defined in Hiller column 4, lines 55-60, where it describes a modulated light source with a "line mirror, an image mirror, and magnification optics". Accordingly, it is clear that the Hiller does not process an image to generate a distortion-compensated image data, but rather teaches controlling the movement of mirrors when creating raster scan lines.

The "line mirror, an image mirror, and magnification optics" referred to by Hiller is the standard method for accomplishing raster-scanned laser displays as described earlier by the Applicant. The Applicant submits that Hiller's control device is intended to compensate for distortions caused by projection geometry via changing the drive waveform for the horizontally scanned line mirror. The vertically scanned image mirror must always be driven at 50Hz or 60Hz typically. The small horizontally scanned line mirror only needs to be big enough to reflect a light bundle that may be of the order of a millimeter or so as laser sources can be considered

almost a point source and the light bundle consists of 3 laser beams, one for each primary color. This line mirror must be driven by a waveform that deflects the mirror at varying horizontal velocities in order to compensate for distortions. For example, the horizontal line may be shortened or lengthened by extending or reducing the horizontal range of motion of the reflected light beam (reducing or extending the angular range of rotation as well as the angular velocity of rotation of the line mirror) and thereby changing the range of motion and the length of a raster line. This can compensate for trapezoidal distortions. The image mirror, being larger, and having more mass, is typically not deflected vertically at varying velocities and is not used to correct for distortions.

The Applicant emphasizes that the large reflecting mirror in Hiller is therefore not used for distortion correction but only for reflecting the image onto the screen. This is a fundamental difference between Hiller and an aspect of Applicant's amended claim 1.

Accordingly, based on the above facts, it is clear that Hiller is teaching to generate a virtually undistorted video picture by deflecting the laser beam point source by small mirrors to create raster line scans which generate the virtually undistorted video picture. Accordingly, the computing device disclosed by Hiller must calculate the deflections that are required for the line and image mirror, and the control device then controls these mirrors accordingly. The Applicant emphasizes that Hiller does not use any "image processing" which is used today in the context of two-dimensional pixel warping, and filtering. Instead, Hiller uses mechanical means for distortion correction. This is another fundamental difference between Hiller and Applicant's amended claim 1.

The Applicant further submits that, unlike the Hiller method which is mechanical, in the presently claimed invention, there is no restriction on the types of distortion that can be corrected because there are no inertial effects to consider as in the case of moving discrete mirrors.

Furthermore, the Applicant submits that it is clear that the large reflecting mirror in Hiller is not used for distortion correction but only for reflecting the raster line scans onto the screen. In fact, Hiller teaches in lines 1 and 2 of column 3 that "any mirror shapes and very small angles of δ can be used". The use of any mirror shape supports the notion that Hiller is not too concerned with the type of mirror that is used, and is definitely not considering the use of a mirror for distortion correction, otherwise Hiller would teach the use of mirrors that have a specific shape for this purpose. In addition, Hiller emphasizes that certain angles or ranges of angles, as well as other geometrical arrangements, must be maintained between various elements of the device (see points 1 to 5 and 8 to 10 in columns 5 and 6). Hiller also teaches that a curved mirror can be used but only for increasing resolution in the final image and not for reducing any geometrical distortion (see lines 24-28 in column 9 of Hiller).

The Applicant submits that, in the light of the foregoing arguments, a person skilled in the art will clearly and quickly recognize that Hiller, on the one hand, and Applicant's amended claim 1, on the other hand, refer to and claim two different systems with two different applications, and as such, Hiller is not citable subject matter against the presently claimed invention.

Regarding Tejima (US 5,274,406), the Applicant submits Tejima is directed towards a CRT display projection device that is based on a beam of electrons originating from a point source (i.e. a CRT cathode). From the electron beam, Tejima produces an image which is then

reflected on a screen via a mirror. Tejima's method is based on raster order scanning, but it does not use a laser source, it uses instead an electron beam which creates light by exciting different phosphors (three different inorganic compounds, one for each CRT, each selected for narrow band emission in R, G, and B light with optimal luminance, chromaticity, and lifetime properties) coated on the CRT faces, and then reflected onto the screen. However, in stark contrast with Hiller, Tejima only uses a large mirror for distortion correction and does not use a mechanical means for distortion correction. In stark contrast to Applicant's amended claim 1, Tejima does not use image processing to aid in distortion correction. In particular, Tejima teaches the use of microscopic stepped sections on a mirror that are similar to a Fresnel lens (see line 67, column 5, to line 2, column 6).

The Applicant submits that the mirror of Tejima and the technology disclosed therein is fundamentally different form that of the presently claimed invention. The drawing on the front page of the Tejima as well as figure 14A shows a mirror, which changes from highly concave to convex, whereas the mirror claimed in the present invention does not have highly concaved surfaces. In addition, the mirrors shown in figures 12C and 13C of Tejima, are clearly only concave in the vertical direction which is in stark contrast with the mirror recited in Applicant's amended claim 1. However, Tejima clearly teaches away from the presently claimed invention: Tejima says in column 7, lines 38-43 that "a curved surface in the reflecting mirror degrades the image and therefore a Fresnel form of mirror implementation is required in order to keep the mirror surface planar".

The Applicant further submits that the specific mirror of the presently claimed invention is designed in conjunction with electronic image processing (so that pre-distorted data is sent to

the micro-display panel to correct for image distortions) which is a completely different operation from that taught by either Tejima and Hiller.

The Applicant further submits that there is no motivation to combine the Hiller and Tejima references. since these references relate to two totally different and separate techniques. Tejima only teaches the use of a large 2-dimensional Fresnel mirror (as this minimizes the extent of curved elements and he says that curved mirrors cause problems) to correct for keystone distortions in a CRT projection system. Hiller on the other hand, does not use a mirror to correct for distortions, only for reflecting an image onto the screen, but uses a dynamically varying scanning mirror movement profile to compensate for distortions. In other words, Hiller teaches a purely mechanical technique which involves the use of varying the position of deflection mirrors at certain rates and angles during operation as well as ensuring that various elements have certain geometrical relationships with one another. Furthermore, although Tejima and Hiller use intensity modulated beam sources, they each teach the use of different sources, namely electrons, and laser light, and then scan these beams with either CRT methods (magnetic or electrostatic deflection) or optical methods (oscillating mirror) to produce an image raster. Accordingly, based on all of the above-noted differences between the two references, no one skilled in the art would consider combining these two references.

In the meantime, the Applicant submits that even if, by some impossibly remote chance, a skilled person in the art thinks of combining Hiller and Tejima, this person would never arrive at the presently claimed invention which is a unique combination of electronic pixel-based image processing and image pre-warping and a unique optical system to achieve a commercially desirable thin structure which the Applicant submits is clearly a huge improvement over the

existing art taught in Hiller and Tejima. The Applicant submits that neither of the Hiller and Tejima references is applicable to micro-display based RPTVs, and neither teaches image processing including image warping and filtering in an RPTV. Rather, the two references deal with different types of raster-scanned rear projection systems. Also, these references do not teach achieving a thin structure like the presently claimed invention. Furthermore, these references do not teach micro-display based RPTVs that use spatial modulation of light (which does not have to be monochromatic as in a laser, and rather than originating from a point source, the light is shaped into a rectangular beam that uniformly illuminates the entire micro-display).

The Applicant submits that the above comments made with respect to Applicant's amended claim 1 also apply to Applicant's corresponding amended claim 21. Furthermore, based on the above comments, the Applicant respectfully submits that amended claims 1 and 21 are novel and inventive over the cited references. In addition, the Applicant respectfully submits that since claims 3-20 and 23-38 depend either directly or indirectly on one of amended claims 1 and 21 respectively, and introduce other patentable features (as discussed below), claims 3-20 and 23-38 are also novel and inventive over the cited references.

With regards to Applicant's claim 3:

The Examiner has referred to "figures 13F and elsewhere of Tajima" to reject this claim. In response, the Applicant submits that Tejima's Figure 13F and all the similar contour figures (i.e. figures 9A, 10A, 12A, 12F, 13A, 13B, and 13F) do not refer to the reflective surface (the mirror) but to lenses. Figure series 14-16 of Tejima do refer to mirrors. However, these mirrors all show a highly concave surface at one end. In addition, the mirrors shown in figures 12C and 13C of Tejima, are clearly only concave in the vertical direction. In addition, the mirrors taught

by Tejima do not have any horizontal convex curvature on their upper portions. This is in stark contrast with Applicant's claim 3. Moreover, Tejima further teaches away from the Applicant's claimed mirror; Tejima states in column 7, lines 38-43 that "a curved surface in the reflecting mirror degrades the image and therefore a Fresnel form of mirror implementation is required in order to keep the mirror surface planar". Hiller also does not teach such curved mirrors. Accordingly, the Applicant respectfully submits that the subject matter of claim 3 is novel and inventive in light of the cited references.

With regards to Applicant's claim 6:

The Examiner is of the opinion: "This is what image processors primarily do".

In response, the Applicant respectfully submits that the subject matter of Applicant's claim 6, when combined with the subject matter of Applicant's base claim 1, constitutes subject matter not taught by Hiller or Tejima. As a matter of fact the devices of Hiller and Tejima would not have the flexibility of adapting to different resolutions as discussed above. Accordingly, the Applicant respectfully submits that claim 6 is novel and inventive over the cited references.

With regards to Applicant's claim 7:

The Examiner is of the opinion that: "Hiller includes a light generator (1), a display device (the projection lens or round part of the box forming the light generator, and projection optics".

In response, the Applicant respectfully submits that, as explained earlier, the device of Hiller is based on mechanical movement of a laser bundle and, as such, does not have a panel display device. Tejima also does not teach such a projection light engine. Accordingly, the

Applicant respectfully submits that the subject matter of claim 3 is novel and inventive over the cited references.

With regards to Applicant's claim 8:

The Examiner is of the opinion that: "Clearly the lens of Tejima is offset from the display axis".

In response, the Applicant submits that the device of Tejima does not include a display device and it is CRT projection based. There is no teaching in Tejima that points to adjusting the angle of a micro-display device (or any image modulation device) relative to the projection lens to further compensate for keystone distortion. Further, Hiller does not teach the features recited in Applicant's claim 8. Accordingly, the Applicant respectfully submits that claim 8 is novel and inventive over the cited references.

With regards to Applicant's claim 9 and 10:

The Examiner is of the opinion that: "Hiller is off-axis for purposes of improving MTF". In response, the Applicant submits that the device of Hiller does not include a display device and it is mechanical laser raster projection based. There is no teaching in Hiller or in Tejima that points to adjusting the angle of a micro-display device relative to the projection lens. Accordingly, the Applicant respectfully submits that claims 9 and 10 are novel and inventive over the cited references.

With regards to Applicant's claim 11:

The Examiner is of the opinion that: "Hiller includes a light generator (r-g-b laser(s)), a micro display (a deflector) and as can clearly be seen such as in figure 9c of Tejima lens elements".

In response, the Applicant submits that the device of Hiller does not include a micro-display device and it is mechanical laser raster projection based. Neither does Hiller's device include an illumination sub-system, which generates a rectangular area light to hit the micro-display device and generate an image. This is also not taught by Tejima. Accordingly, the Applicant respectfully submits that claim 11 is novel and inventive over the cited references.

With regards to Applicant's claim 12:

The Examiner refers to column 2 lines 56-67 of Hiller and is of the opinion that Hiller teaches a micro-display device that displays an image that is compensated for keystone and other spatial distortions.

In response, the Applicant submits that the device of Hiller does not include a micro-display device and that Hiller teaches distortion correction by changing the horizontal extent and speed of deflection of a laser beam bundle as taught in column 2, lines 56-67 of Hiller. This is clearly different than Applicant's claim 12. Further, Tejima only teaches the use of a mirror for distortion correction. Accordingly, the Applicant respectfully submits that claim 12 is novel and inventive over the cited references.

With regards to Applicant's claim 16:

The Examiner is of the opinion that both Hiller and Tejima are rear projection type display systems.

In response, the Applicant submits that devices of Hiller and Tejima, as discussed in the remarks about the Applicant's independent claims 1 and 21 above, are fundamentally different from the Applicant's presently claimed system and, as such, the subject matter of claim 16, depending on independent claim 1, is novel and inventive over the cited references.

With regards to Applicant's claim 17:

The Examiner has cited figure 15A of Tejima and argued that Tejima teaches replacing the curved mirror (figure 14A) with a Fresnel type mirror.

In response, the Applicant submits that, as discussed above, the Fresnel mirror of Tejima, as shown in figure 15A, is different from that taught and claimed by the Applicant. Figure series 14-16 of Tejima show mirrors, which have highly concave surface at one end and have a different shape than the Applicant's curved mirror. In addition, the mirrors shown in figures 12C and 13C of Tejima, seem to be only concave in the vertical direction. The Fresnel mirror of figure 14A Tejima is based on the same design. The Tejima Fresnel mirror is therefore different from that taught and claimed by the Applicant. Moreover, Tejima uses a Fresnel surface for a different reason: Tejima says in column 7, lines 38-43 that "a curved surface in the reflecting mirror degrades the image and therefore a Fresnel form of mirror implementation is required in order to keep the mirror surface planar". The Fresnel mirror claimed in the present invention is used to make the housing thinner by eliminating the sag of the curved mirror (of the order of 1" to 2") while retaining the same optical performance (due to the Fresnel surfaces) necessary for distortion correction.

The Applicant therefore submits that claim 17 is novel and inventive over the cited references.

With regards to Applicant's claims 21, 23, 26-30, 34, and 35:

The Applicant submits that the comments provided for the corresponding system claims above are applicable to these claims. Accordingly, the Applicant respectfully submits that claims 21, 23, 26-30, 34 and 35 are novel and inventive over the cited references.

With regards to Applicant's claims 39-42:

The Examiner referred to his previous comments and is of the opinion that the at least one mirror of Hiller in view of Tejima meets the Applicant's claimed curved mirror.

In response, the Applicant refers to the comments made above which support that Tejima does not teach a curved mirror having the features recited in Applicant's claims 39-42. Furthermore, Tejima teaches away from using a curved mirror as previously pointed out by the Applicant. Accordingly, the Applicant respectfully submits that Applicant's claims 39-42 are novel and inventive over the cited references.

With regards to Applicant's claims 4, 5, 24 and 25:

The Examiner has additionally cited figure 1 and paragraphs 23-26 of Suzuki. The Examiner is of the opinion that: *"Hiller in view of Tejima teaches a projection system and associated method, which among other things includes a curved mirror. Hiller, however does not teach a lens that is an aspherical rotationally non-symmetric lens positioned prior to the curved mirror. Suzuki teaches in figure 1 a projection optical system including a mirror (16) and a lens (15). Suzuki teaches in paragraphs 22-26 that the lens is an aspherical lens, which is designed to cancel the curvature of field of the reflecting part. Accordingly, since it is desirable to eliminate such aberrations it would have been obvious to include the lens of Suzuki in the projector of Hiller in view of Tejima".*

In response, the Applicant respectfully submits that there is no motivation to combine the Hiller and Suzuki references. The Applicant submits that Suzuki relates to a purely optical correction system that corrects for only certain distortions, namely pincushion and barrel distortions (see Figures 2, 3, 7, and claim 1 in Suzuki). In particular, Suzuki teaches the use of a

refracting optical lens and a curved convex mirror in a projecting optical system to correct for pincushion distortion of the curved convex mirror whereas Hiller teaches the use of a mechanical means for adjuring raster scan lines during image formation to compensate for distortion caused by the reflecting surfaces used in the projector system. Accordingly, Suzuki and Hiller teach two different techniques to correct for distortion. Furthermore, Tejima does not teach the use of a lens with a shape based on a curved mirror. The Applicant also refers to earlier comments to support that there is no motivation to combine the Tejima and Hiller references. Accordingly, the Applicant respectfully submits that someone skilled in the art would not think to combine the Hiller, Tejima and Suzuki references.

In addition, the Applicant submits that Suzuki does not teach a mirror as claimed in Applicant's claim 1 and that Applicant's claims 4 and 5 recite an aspherical rotationally non-symmetric lens being shaped to compensate for any defocusing caused by the aspherical rotationally non-symmetric mirror of Applicant's claim 1. Since Suzuki does not teach a mirror as claimed in Applicant's claim 1, then the Applicant submits that Suzuki cannot possibly teach a lens as claimed in Applicant's claims 4 or 5. Furthermore, even if these references are combined, they still do not teach the elements claimed by the Applicant, as discussed previously.

Accordingly, based on the above comments, the Applicant submits that Applicant's claims 4 and 5, and for similar reasons corresponding method claims 24 and 25, are novel and inventive over the cited references.

With regards to Applicant's claim 18-20 and 36-38:

The Examiner has additionally cited figure 1 and paragraphs 12-14 of Nishizawa.

In response, the Applicant submits that Nishizawa only teaches luminance and tone correction between consecutive image frames and does not teach distortion and luminance non-uniformity correction in display devices. For instance, Nishizawa teaches how to adjust an image frame in an otherwise dark scene when a spotlight is suddenly turned on (see paragraphs 12-18 in Nishizawa). Such corrections use normalized luminance histogram for handling drastic scene changes (see paragraphs 12-18 and figures 1, 3, and 4 in Nishizawa). These paragraphs do not teach processing the luminance data on a frequency band level. Secondly, paragraph 164 of Nishizawa teaches a luminance converting unit 32 that includes two latch units, a selector circuits, a comparator, accumulators and a multiplier. There is no mention of any structure that can provide different frequency bands or filtering. Accordingly, it is clear that Nishizawa does not teach processing different spectral passbands of input image data and that Nishizawa does not teach distortion and luminance non-uniformity correction in display devices.

In contrast, the Applicant teaches that luminance non-uniformity correction is done in a display system to correct for brightness and luminance uniformity limitations on the light engine, lens vignettes etc. that are always present in the display system (see paragraph 89 in the subject application). Likewise, the lateral color shift correction, taught in the subject application, refers to correction of primary colors of different optical light paths (see paragraph 137 in the subject application) which is not the subject matter of Nishizawa.

Accordingly, the Applicant respectfully submits that the luminance non-uniformity and lateral color shift corrections disclosed in the subject application (see paragraphs 89 and 137) and recited in claims 18-20 and 36-38 are not taught by Nishizawa. It is therefore submitted that claims 18-20 and 36-38 are novel and inventive over the cited references.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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